

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
RESEARCH AND TECHNOLOGY RESUME

TITLE

INFRARED OBSERVATIONS OF SMALL SOLAR-SYSTEM BODIES

PERFORMING ORGANIZATION

JET PROPULSION LABORATORY
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INVESTIGATOR'S NAME

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DESCRIPTION (a. Brief statement on strategy of investigation; b. Progress and accomplishments of prior year; c. What will be accomplished this year, as well as how and why; and d. Summary bibliography)

a) OBJECTIVES

(TASK 1): To measure eclipse disappearance and reappearance curves for the Galilean satellites Europa and Ganymede to determine the penetration scale length for sunlight and thus to determine the extent to which the solid-state greenhouse effect is operating on these two bodies. I will use the IRTF at Mauna Kea Observatory to obtain flux measurements at narrow-band wavelengths of 8.7 and 20 μm during several eclipse disappearances and reappearances of Europa and Ganymede. The measurements will be interpreted using solid-state greenhouse models developed by D. Matson and me.

(TASK 2): To measure the reflectance spectra of the icy satellites of Jupiter, Saturn, Uranus and Neptune in the region 2.0 to 2.5 μm using the 32-element InSb photodiode array spectrometer of the IRTF at Mauna Kea Observatory. The specific objective is to search for methane, ammonia and carbon monoxide ices and clathrates on icy surfaces in the outer solar system. The data will allow upper limits to be placed on the amount of these chemical species present. Specific targets are Enceladus, Ariel, Titania, and Triton.

b) PROGRESS: A major accomplishment during last year is the recognition of and modeling of the solid-state greenhouse effect for icy satellites. Recent observations of eclipse reappearances suggest that this effect may in fact be observed on Europa and Ganymede. Also the PI has obtained important new data on Europa and Enceladus. Evidence for the transient presence of a volatile, perhaps $\text{NH}_3 \cdot \text{OH}$, on Europa has been obtained; A paper is in press in *Icarus*. Newly obtained spectra of Enceladus suggest that it does not at present have ammonia or methane in detectable quantities on its surface. A paper is in preparation.

c) PROPOSED WORK: First, it is proposed to obtain additional observations of eclipse reappearances and disappearances of Europa and Ganymede, and to extend our existing solid-state greenhouse models to include a surface which is stratified in density. We will use the data and the models to get an estimate of the extent of solid-state greenhousing on Ganymede and Europa. Second, it is proposed to observe Ariel, Dione, Rhea and Titania in the search for volatile surface constituents.

d) SUMMARY BIBLIOGRAPHY: Brown, R. H. and D. L. Matson (1987). Thermal effects of insolation propagation into the regoliths of airless bodies. *Icarus* 72, 84-94.

Matson, D. L. and R. H. Brown (1988). Solid-state greenhouses and their implications for icy satellites. *Icarus*, in press.

Brown, R. H. et al. (1988). Search for volatiles on icy satellites I: Europa. *Icarus*, in press.

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